PATENT ABSTRACTS OF JAPAN

(11) Publication number: 08-315819

(43) Date of publication of application: 29.11.1996

(51)Int.CI.

H01M 4/58

H01M 4/02

H01M 10/40

(21)Application number: 07-123622 (71)Applicant: Yuasa Cooperation

(22) Date of filing:

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CLAIMS

[Claim(s)]

[Claim 1] The secondary battery that use a positive active material expressed by Li_aNi_bM¹_cM²_dM³_eO₂ (wherein, M¹ is at least one sort of elements chosen out of Co, Mn, and Fe, M2 is at least one sorts of elements chosen out of B, Al, In, and Sn, and M³ is at least one sort of elements chosen out of Mg, Zn.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0009] [The purpose of this invention]

To offer the long lasting lithium secondary battery which has an excellent rate capability.

[0021] (Example 1- coin cell A1)

- LiOH·H₂O, Ni₂CO₃, CoCO₃, B₂O₃, and MgO were used.
- The mole ratio, Li : Ni : Co : B : Mg is 1.03 : 0.88 : 0.10 : 0.01 : 0.01.
- The mixture was calcinated at 750 degrees C under oxygen atmosphere for 20 hours. After calcination, it was cooled in dry air, and was milled.
- Cathode: Acetylene black: PTFE = 85:10:5

Positive electrode is dried at 200 degree C in vacuum.

Counter electrode is Li metal.

Electrolyte is EC/DEC (1:1 vol%)

[0024] (Example 2 - coin cell A2)

- LiOH·H₂O, Ni₂CO₃, CoCO₃, Al₂(NO₃)₃, and MgO were used.
- The mole ratio, Li: Ni: Co: Al: Mg is 1.03: 0.88: 0.10: 0.01: 0.01.

[0025] (Example 3 - coin cell A3)

- LiOH·H₂O, Ni₂CO₃, CoCO₃, In(NO₃)₃·xH₂O and MgO were used.
- The mole ratio, Li: Ni: Co: In: Mg is 1.03: 0.88: 0.10: 0.01: 0.01.

[0026] (Example 4 - coin cell A4)

- LiOH·H₂O, Ni₂CO₃, CoCO₃, SnO and MgO were used.
- The mole ratio, Li: Ni: Co: Sn: Mg is 1.03: 0.88: 0.10: 0.01: 0.01.

[0027] (Example 5 - coin cell A5)

- LiOH·H₂O, Ni₂CO₃, CoCO₃, B₂O₃, and ZnO were used.
- The mole ratio, Li: Ni: Co: B: Zn is 1.03: 0.88: 0.10: 0.01: 0.01.

[0028] (Example 1 of a comparison - coin cell B1)

- LiOH·H₂O, Ni₂CO₃ were used.
- The mole ratio, Li: Ni is 1.03: 1.00.

[0029] (Example 2 of a comparison – coin cell B2)

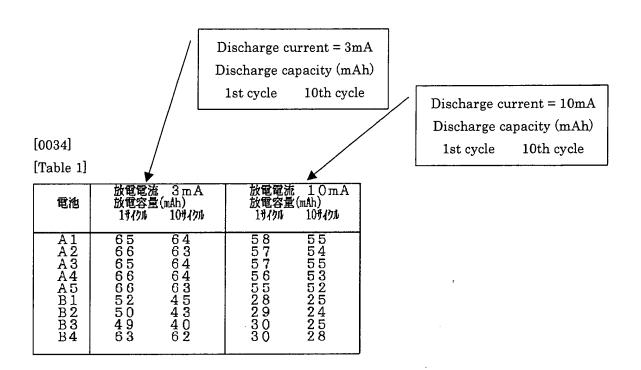
- LiOH·H₂O, Ni₂CO₃, CoCO₃ were used.
- The mole ratio, Li: Ni: Co is 1.03:0.90:0.10.

[0030] (Example 3 of a comparison - coin cell B3)

- LiOH·H₂O, Ni₂CO₃, B₂O₃ were used.
- The mole ratio, Li: Ni: B is 1.03: 0.90: 0.10.

[0031] (Example 4 of a comparison - coin cell B4)

- LiOH·H₂O, Ni₂CO₃, CoCO₃, B₂O₃ were used.
- The mole ratio, Li: Ni: Co: B is 1.03:0.89:0.10:0.01



[0035] As shown in Table 1, the cells A1, A2, A3, A4 and A5 by this invention had a large initial discharge capacity compared with the comparison cell B1, B2, and B3. Furthermore, the cells A1, A2, A3, A4 and A5 by this invention had a good rate capability compared with the cell B4.